

**Report to the NEPEC on the Feb. 2008
Workshop on
Slow slip and tremor - earthquake hazard
implications and opportunities to educate.**



What and where are aseismic 'slow' slip, tremor & earthquakes and why care?

What's required to assess earthquake hazard?

What's the connection between slow slip, tremor & earthquakes?

The direct links.

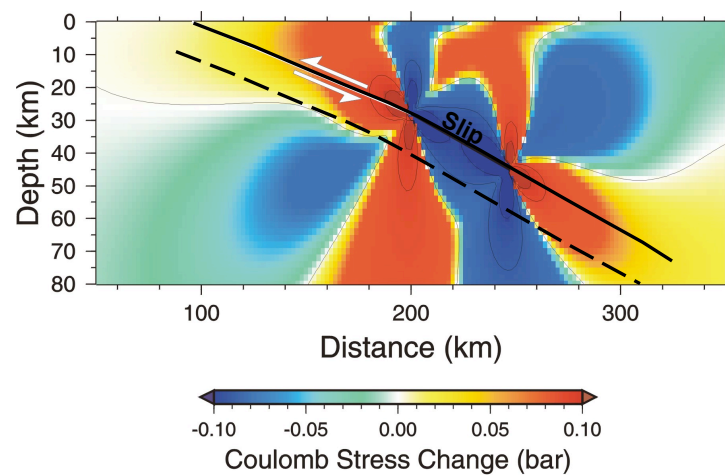
The indirect links.

Educational opportunities and needs, policy implications, and beyond..

Goal of Evaluating Basis for Warnings of Elevated Probability during Slow Slip Events

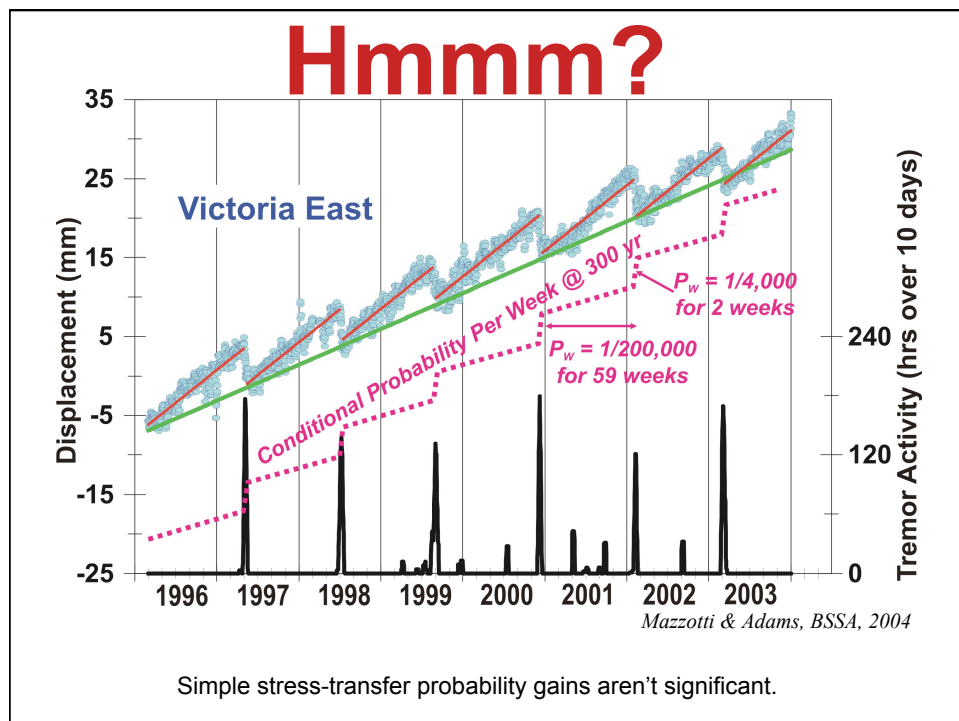
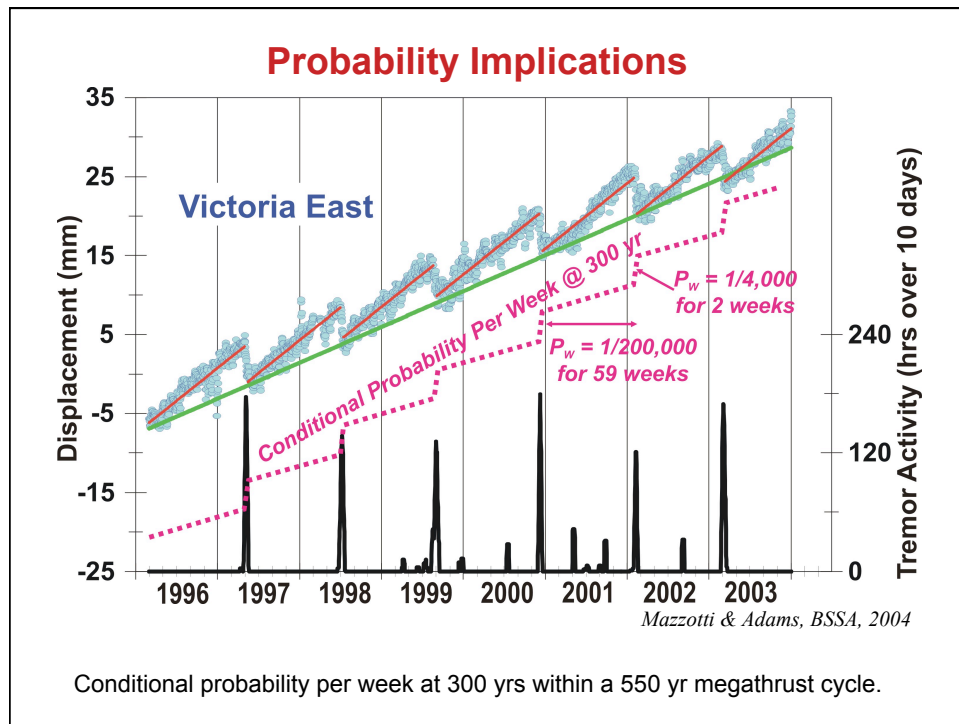
- NEPEC's motivation for meeting
- Most of meeting was on scientific issues

Loading of the up-dip locked zone is tiny (<0.1 bar).

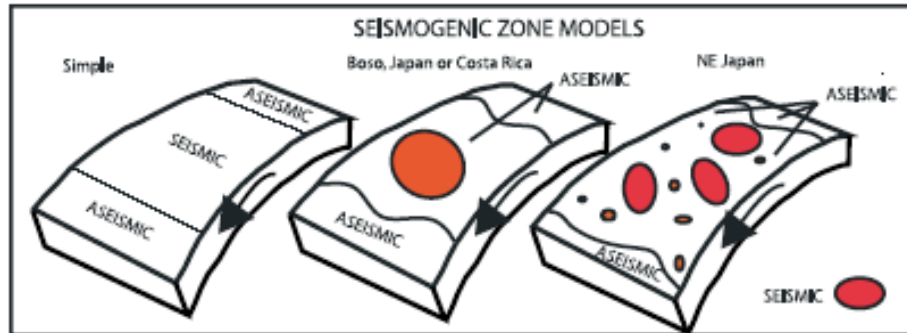


Dragert et al., EPS 2004

Cummulative stress over 550 years $\sim 2.2\text{-}4.5$ MPa.

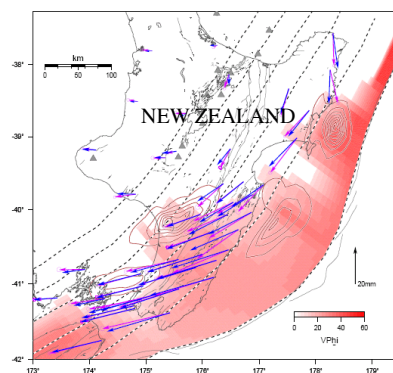


USEFUL!

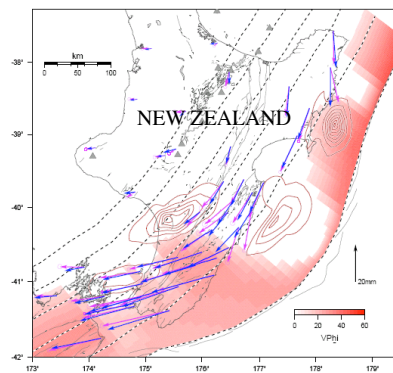


Schwartz & Rokosky, 2007, Rev. Geophys.

Higher Resolution Maps of the Locked Zone.



*Interseismic Slip Deficit
without Slow Slip*



*Interseismic Slip Deficit
with Slow Slip*

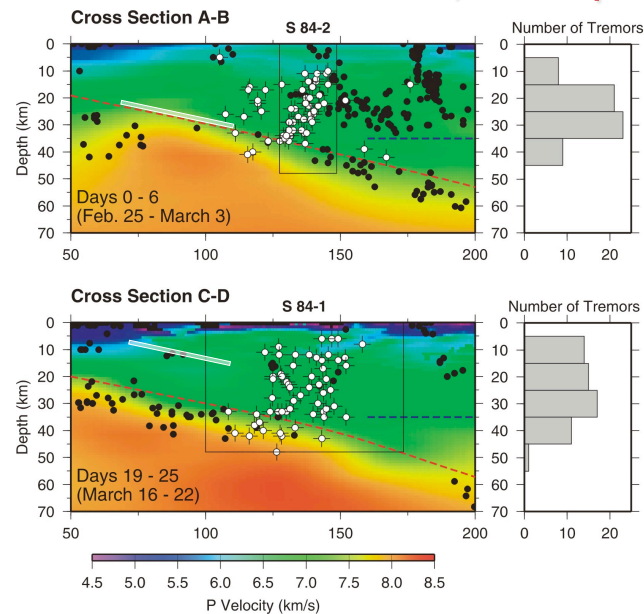
McCaffrey, 2008

**What and where are aseismic, 'slow' slip, tremor & earthquakes?
Why care?**

What's required to assess earthquake hazard?

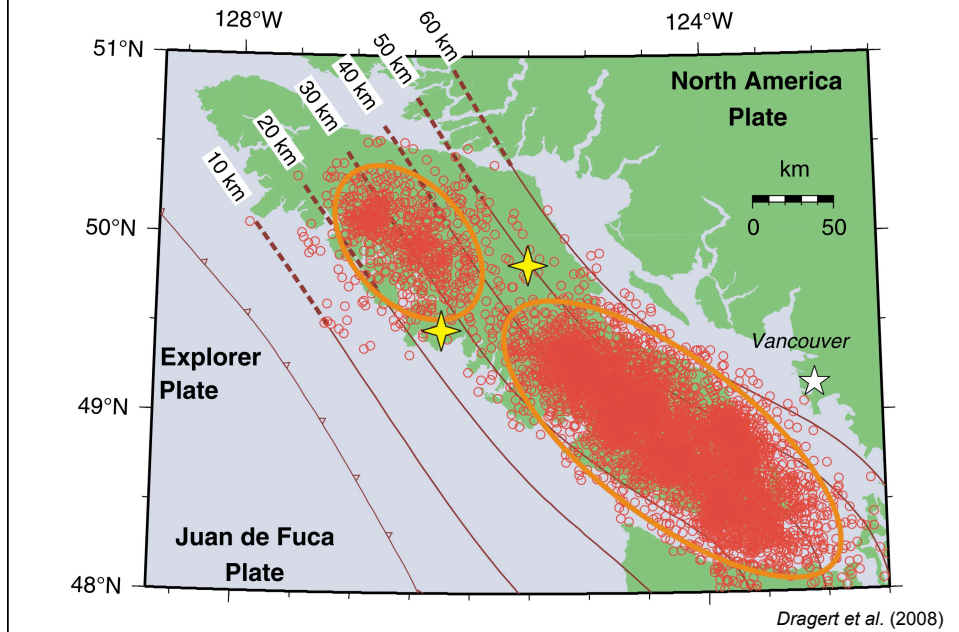
**What's the connection between slow slip, tremor & earthquakes?
The direct links.**

Anti-correlated Ambient Tremor, Slow Slip & Seismicity

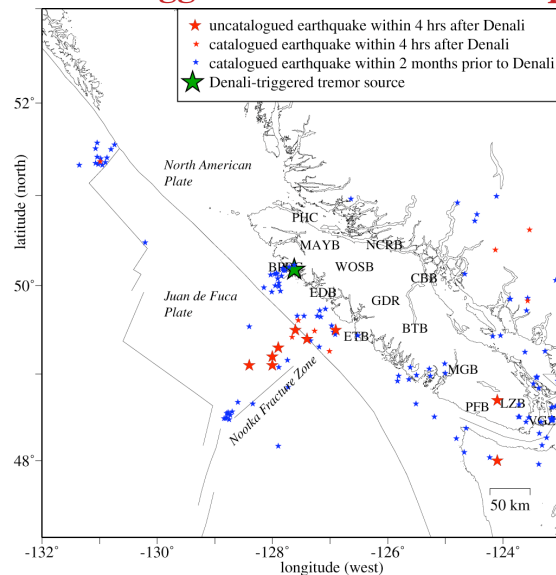


Kao et al., Nature, 2005

Anti-correlated Tremor & Large (Crustal) Earthquakes

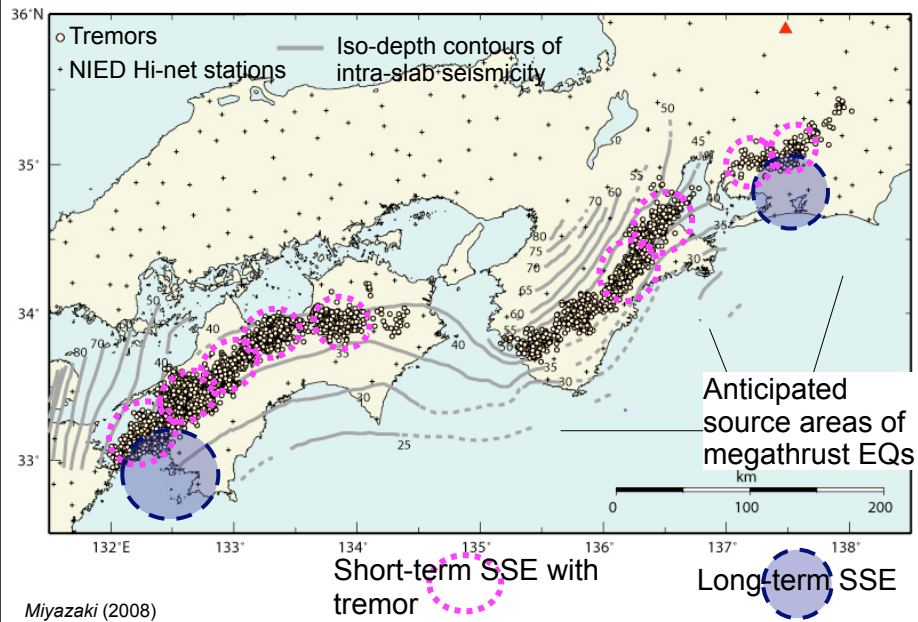


Anti-correlated Triggered Tremor & Earthquakes

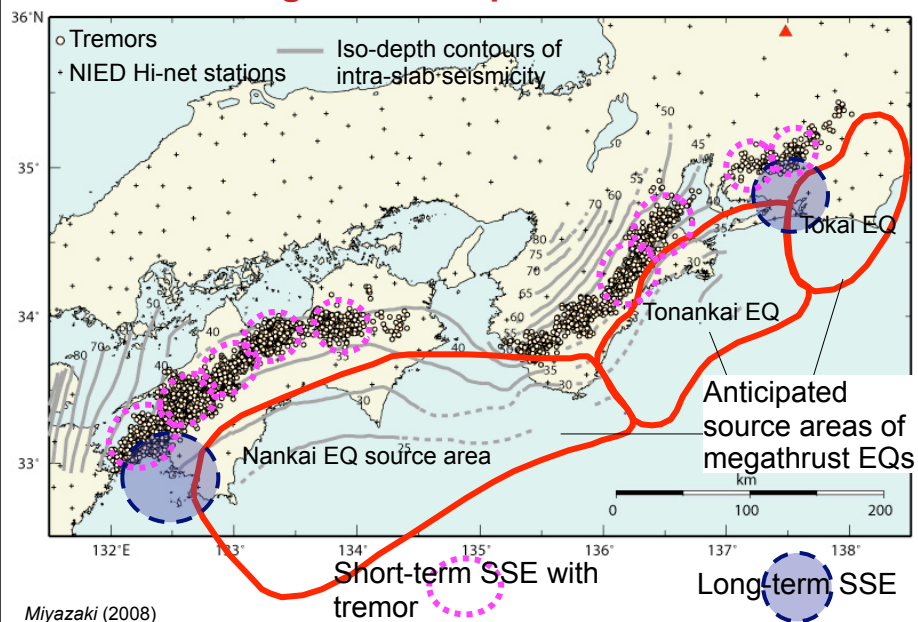


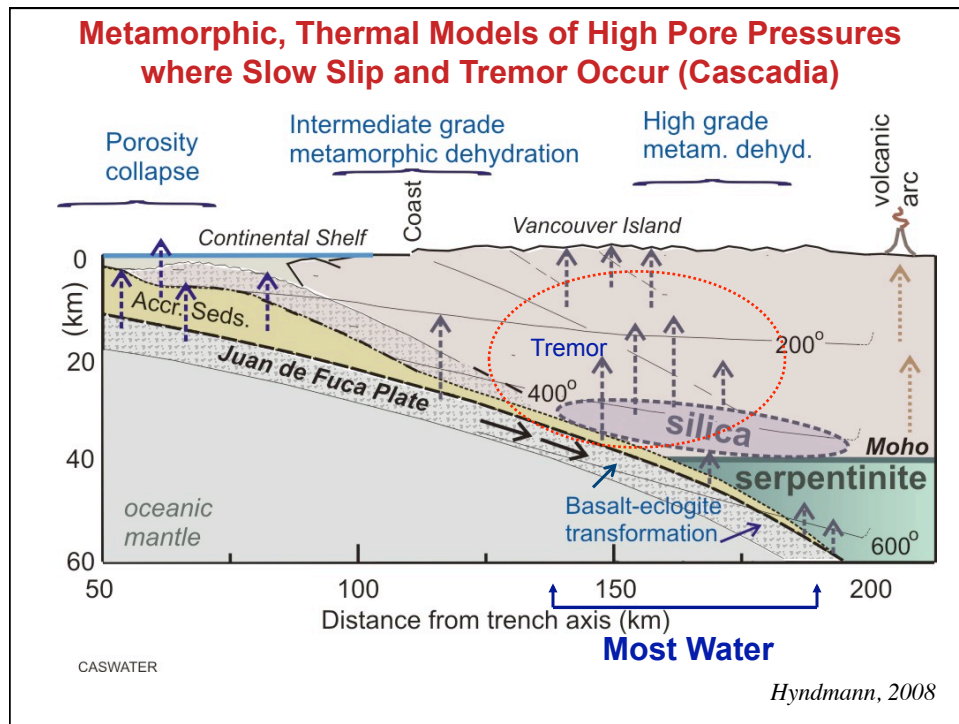
Anti-correlation expected if tremor & earthquakes reflect different rheologic or frictional properties.

Slow Slip & Tremor Delineates Downdip Edge of Megathrust Rupture Planes



Slow Slip & Tremor Delineates Downdip Edge of Megathrust Rupture Planes





Policy/Response Implications

Current estimates of the size of and uncertainty in probability changes **at present** make related public hazard warnings premature.

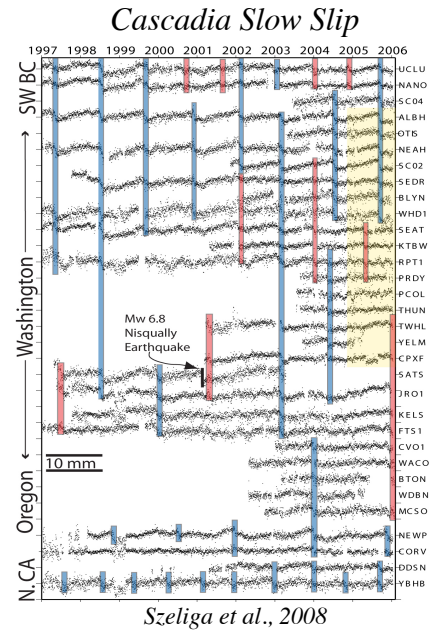
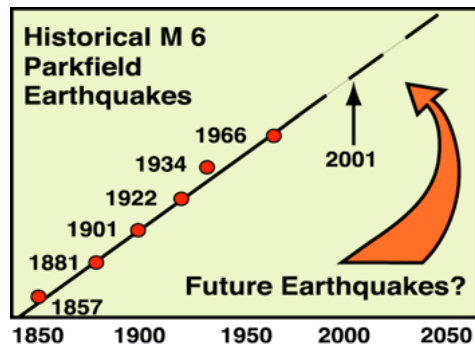
Application to hazard will likely be through improved definition of the locked zone.

Planning across state/national/international boundaries for various realistic scenarios is needed.

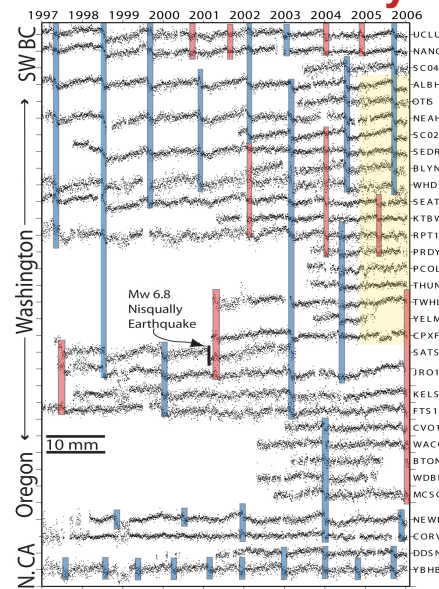
The repeating nature of tremor and slip provides a reminder to update scenarios and communications between the research community and emergency managers periodically as scientific knowledge increases.

Educational Opportunities: Predictability!

Much more reliable than Parkfield....



Frequency: Slow Slip & Tremor Happen Somewhere in Cascadia Every 3 months!



A Chance to Educate & Excite the Public, Particularly Where Earthquakes are Infrequent



Workshop Action Items

& What's Been Done

Set up coordinated web site (e.g., EarthScope "wrapper" site with links to other sites).

* Started at <http://www.earthscope.org/science/cascadia>

* Facebook 'group' (25 members) at <http://www.facebook.com/group.php?gid=23799680033>

Scientists and emergency managers meet to coordinate how to respond to 'extraordinary' tremor, slow slip, or earthquake activity.

* Mendenhall Opportunity posted "Cascadia Subduction Zone Seismic and Aseismic Slip Scenarios: Implications for Public Policy"

Plan a broad (in geography and discipline) Chapman conference.

*People say this is a good idea, but no one wants to take charge!

Workshop Action Items

& What's Been Done

Publish a JGR special volume.

**Accepting papers until September 1.*

***Now closed with more than 20 papers*

Publish a workshop report in EOS.

** In press.*

Write a workshop report.

** USGS Open-file Report in review.*

** Nature Geoscience summary published.*

Workshop Action Items

& What's Planned

Continue to develop web sites.

Scientists and emergency managers meet to coordinate how to

respond to 'extraordinary' tremor, slow slip, or earthquake activity.

May be pursued through a Mendenhall, may be otherwise (no specific plans yet).

Plan/host a focused symposium to exchange/integrate findings related to the 2007 & 2008 Cascadia ETS events. These have datasets of unprecedented quality, variety, etc.

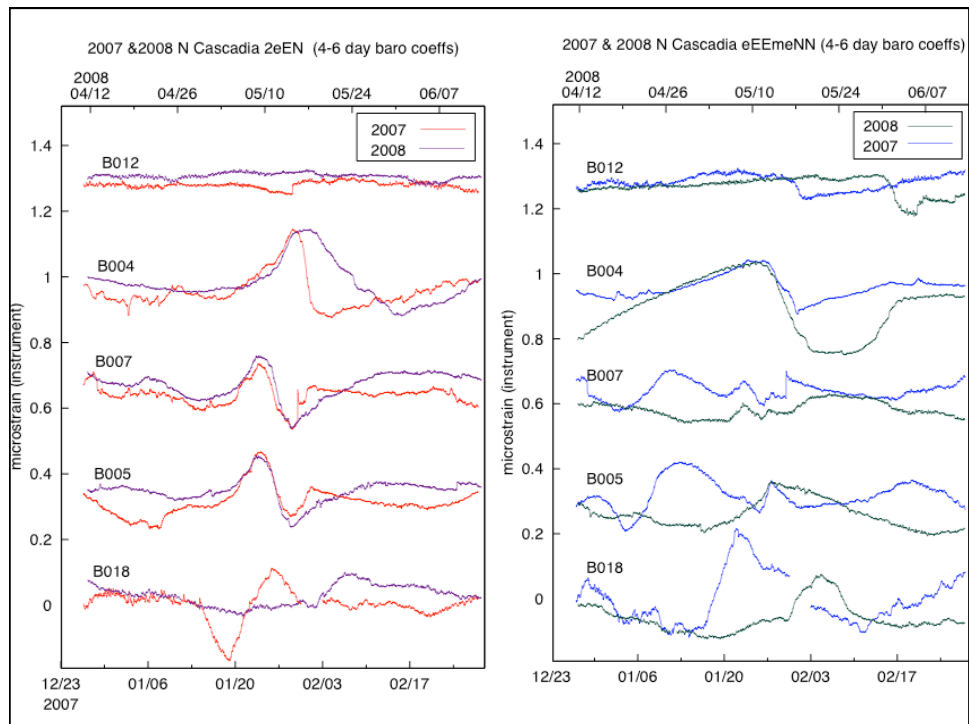
Modified Statement from GSC



When – Although ETS alone will not help us predict an earthquake at this time, ETS may provide the basis for improved forecasting. Each ETS episode adds a small amount of stress on the locked portion of the subduction zone. This implies that as the stress level increases with each ETS event, one of them could trigger a great earthquake. Therefore, the likelihood of a great earthquake is enhanced during ETS. However, since ETS episodes of various sizes occur at different times all up and down the full length of the Cascadia subduction zone, we cannot yet say which ETS event will be the likely trigger.

PBO Borehole Strainmeters





Near-simultaneous
onset of tremor
and strain signal
(South Puget
Sound)

